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CONCISE EXPLANATION

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< Description on the Relevance>
The invention is a background art of the present application.

※ The translation of the above document (JP 2002-313764) is attached hereto. It is available through the Japan Patent Office website (http://www.jpo.go.jp).

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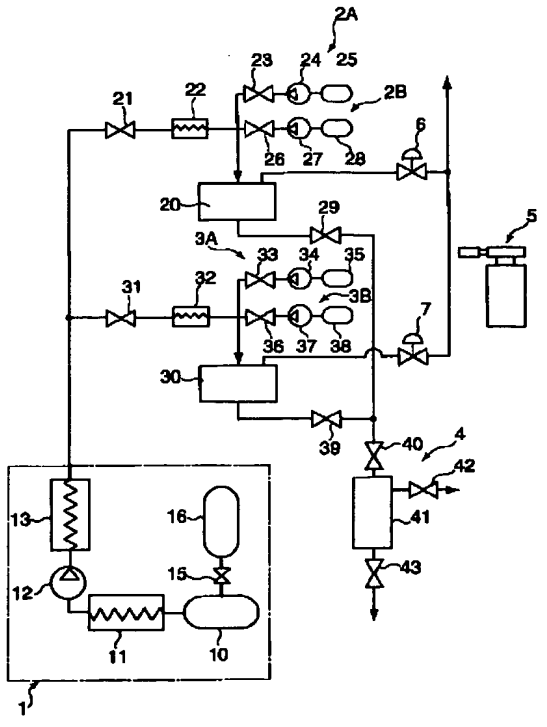
最終頁に続く

(54)【発明の名称】　高圧処理装置

(57)【要約】
【課題】　クリーンルーム内に設置可能な高圧処理装置において、必要なタイミングで薬液を効率よく供給することができ、コスト低減に有効な高圧処理装置を提供すること。
【解決手段】　被処理体に加圧下で高圧流体と高圧流体以外の薬液とを接触させて被処理体上の不要物質の除去処理を行うための装置であって、複数の高圧処理チャンバーと、これらの高圧処理チャンバーに高圧流体を供給するための共通の高圧流体供給手段と、処理後に前記高圧処理チャンバーから排出される高圧流体と薬液との混合物から気体成分を分離するための分離手段と、前記各高圧処理チャンバーに対し、被処理体を出入するための共通の出入手段とを備え、高圧処理チャンバーに薬液を供給するための薬液供給手段を、各高圧処理チャンバー毎に設けた高圧処理装置である。



【特許請求の範囲】
【請求項１】　被処理体に加圧下で高圧流体と高圧流体以外の薬液とを接触させて被処理体上の不要物質の除去処理を行うための装置であって、
複数の高圧処理チャンバーと、
これらの高圧処理チャンバーに高圧流体を供給するための共通の高圧流体供給手段と、
処理後に前記高圧処理チャンバーから排出される高圧流体と薬液との混合物から気体成分を分離するための分離手段と、
前記各高圧処理チャンバーに対し、被処理体を出入するための出入手段とを備え、
高圧処理チャンバーに薬液を供給するための薬液供給手段を、各高圧処理チャンバー毎に設けたことを特徴とする高圧処理装置。
【請求項２】　各高圧処理チャンバー毎にそれぞれ複数の薬液供給手段を設けたものである請求項１に記載の高圧処理装置。
【請求項３】　各高圧処理チャンバー毎にそれぞれ分離手段を設けたものである請求項１または２に記載の高圧処理装置。
【請求項４】　各高圧処理チャンバーへの入口近傍に加熱手段を設けたものである請求項１～３のいずれかに記載の高圧処理装置。
【請求項５】　前記分離手段と前記高圧流体供給手段とを連結する連結管を設けると共に、この連結管に液化手段を配設し、分離手段で分離された気体成分を高圧流体として再利用するように構成した請求項１～４のいずれかに記載の高圧処理装置。
【請求項６】　各高圧処理チャンバーと出入手段とを１つの箱状体の中に配設した請求項１～５のいずれかに記載の高圧処理装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、半導体基板のような表面に微細な凹凸（微細構造表面）を有する被処理体を効率的に洗浄するときに最適の高圧処理装置に関し、例えばクリーンルームに設置されて、半導体製造プロセスで基板表面に付着したレジスト等の汚染物質を基板から剥離除去するために用いられる高圧処理装置に関するものである。また本発明は、基板を乾燥または現像するための高圧処理装置に関するものである。
【０００２】
【従来の技術】半導体製造プロセスの中でレジストを用いてパターン形成する場合、パターン形成後に不要となるレジストや、エッチングの時に生成して基板上に残存してしまうエッチングポリマー等の不要物・汚染物質を基板から除去するための洗浄工程が必須工程となる。
【０００３】半導体製造プロセスはクリーンルーム内で行われるため、洗浄工程もクリーンルーム内において行うことが望ましい。しかし、クリーンルームはその建設だけでなく、維持においてもかなり経費がかかるため、洗浄装置も、設置面積が小さく、機能性、洗浄性に優れていることが求められる。
【０００４】従来は、半導体洗浄方法として、剥離液（洗浄液）に半導体基板等を浸漬し、その後アルコールや超純水によってリンスする湿式洗浄方法が採用されてきた。剥離液には有機系や無機系の化合物が用いられてきたが、液体の表面張力や粘度が高い等の原因によって、微細化されたパターンの凹部に剥離液を浸透させることができないという問題や、剥離液やリンス液を乾燥させる際に、気液界面に生じる毛管力や乾燥の際の加熱による体積膨張等によってパターンの凸部が倒壊してしまう問題等があったため、最近では、例えば超臨界二酸化炭素のような低粘度の高圧流体を剥離液またはリンス液として使用する検討がなされている。
【０００５】例えば、特開平５－２２６３１１号には、クリーンルーム内に設置可能な洗浄装置であって、超臨界流体で半導体ウエハ表面の水分、油脂分、エステル等の汚染物を溶解除去するための装置が開示されている。高圧または超臨界流体として、大気圧下で簡単に気化し、安全性に優れ、しかも安価である二酸化炭素を用いるとすると、二酸化炭素流体はヘキサン程度の溶解力を有しているため、上記公報に開示されているように、基板表面の水分や油脂分等の除去は容易に行えるが、レジストやエッチングポリマー等の高分子汚染物質に対する溶解力は不充分であって、二酸化炭素単独でこれらの汚染物質を剥離・除去することは難しい。
【０００６】このため、二酸化炭素にさらに洗浄用薬液を添加して、高分子汚染物質を剥離・除去することが望ましいと考えられる。この洗浄用薬液は、レジストの種類や汚染物質の付着量等によって、添加量や加えるタイミングを種々変化させる必要があるが、前記特開平５－２２６３１１号では、超臨界流体のみで洗浄することを前提としているため、洗浄用薬液の供給手段については、何ら考慮されていない。さらに、高圧処理チャンバーから導出される汚染物質を含む高圧流体の処理を、エネルギーロス（コスト）と高圧流体の純度等のバランスを採りながら行えるように、装置構成をする必要がある。
【０００７】
【発明が解決しようとする課題】そこで本発明では、クリーンルーム内に設置可能な高圧処理装置において、必要なタイミングで薬液を効率よく供給することができ、コスト低減に有効な高圧処理装置を提供することを課題として掲げた。
【０００８】
【課題を解決するための手段】本発明の高圧処理装置は、被処理体に加圧下で高圧流体と高圧流体以外の薬液とを接触させて被処理体上の不要物質の除去処理を行う

ための装置であって、複数の高圧処理チャンバーと、これらの高圧処理チャンバーに高圧流体を供給するための共通の高圧流体供給手段と、処理後に前記高圧処理チャンバーから排出される高圧流体と薬液との混合物から気体成分を分離するための分離手段と、前記各高圧処理チャンバーに対し、被処理体を出入するための出入手段とを備え、高圧処理チャンバーに薬液を供給するための薬液供給手段を、各高圧処理チャンバー毎に設けたところに要旨を有する。

【０００９】高圧処理チャンバーを複数備えているので処理工程の効率が上がり、それぞれのチャンバー毎に薬液供給手段を設けたため、各チャンバー毎に異なる処理を行うことができる。

【００１０】各高圧処理チャンバー毎にそれぞれ複数の薬液供給手段を設ける構成を採用すれば、２種類以上の薬液を別々のタイミングで高圧処理チャンバーへ供給することができる。各高圧処理チャンバー毎にそれぞれ分離手段を設ける構成を採用すれば、汚染された高圧流体から気体成分を分離するときの条件を高圧処理チャンバーの洗浄条件等に応じて適宜変更できる。各高圧処理チャンバーへの入口近傍に加熱手段を設ける構成を採用すれば、各高圧処理チャンバーの処理温度をチャンバー毎に変更することができる。

【００１１】前記分離手段と前記高圧流体供給手段とを連結する連結管を設けると共に、この連結管に液化手段を配設し、分離手段で分離された気体成分を前記高圧流体として再利用する構成を採用すれば、高圧流体を循環使用することができる。

【００１２】各高圧処理チャンバーと出入手段とを１つの箱状体の中に配設する構成を採用すれば、箱状体内にリーク検知器を設置しておくことにより、高圧処理チャンバーから高圧流体のリークが生じた場合に、速やかに必要な安全措置を執ることができる。また、高圧処理チャンバーと出入手段とをクリーンルーム内に設置して、他の手段はクリーンルーム外に設置すると、クリーンルーム内に占める高圧処理装置の占有面積は小さくなるため、好適である。

【００１３】

【発明の実施の形態】本発明の高圧処理装置における処理とは、例えばレジストが付着した半導体基板のように汚染物質が付着している被処理体から、汚染物質を剥離・除去する洗浄処理が代表例としてあげられる。被処理体としては、半導体基板に限定されず、金属、プラスチック、セラミックス等の各種基材の上に、異種物質の非連続または連続層が形成もしくは残留しているようなものが含まれる。また、洗浄処理に限られず、高圧流体と高圧流体以外の薬液を用いて、被処理体上から不要な物質を除去する処理（例えば、乾燥・現像等）は、全て本発明の高圧処理装置の対象とすることができる。

【００１４】本発明の高圧処理装置において用いられる高圧流体としては、安全性、価格、超臨界状態にするのが容易、といった点で、二酸化炭素が好ましい。二酸化炭素以外には、水、アンモニア、亜酸化窒素、エタノール等も使用可能である。高圧流体を用いるのは、拡散係数が高く、溶解した汚染物質を媒体中に分散することができるためであり、より高圧にして超臨界流体にした場合には、気体と液体の中間の性質を有するようになって微細なパターン部分にもより一層浸透することができるようになるためである。また、高圧流体の密度は、液体に近く、気体に比べて遙かに大量の添加剤（薬液）を含むことができる。

【００１５】ここで、本発明における高圧流体とは、１ＭＰａ以上の圧力の流体である。好ましく用いることのできる高圧流体は、高溶解性、低粘度、高拡散性の性質が認められる流体であり、さらに好ましいものは超臨界状態または亜臨界状態の流体である。二酸化炭素を超臨界流体とするには３１℃、７．１ＭＰａ以上とすればよい。洗浄並びに洗浄後のリンス工程や乾燥・現像工程等は、５～３０ＭＰａの亜臨界（高圧流体）または超臨界流体を用いることが好ましく、７．１～２０ＭＰａ下でこれらの処理を行うことがより好ましい。以下、本発明の高圧処理装置で行う除去処理として、洗浄処理を代表例として説明するが、前記したように高圧処理は洗浄処理のみには限られない。

【００１６】本発明の高圧処理装置においては、半導体基板に付着したレジストやエッチングポリマー等の高分子汚染物質も除去するため、二酸化炭素等の高圧流体だけでは洗浄力が不充分である点を考慮して、薬液を添加して洗浄処理を行う。薬液としては、洗浄成分として塩基性化合物を用いることが好ましい。レジストに多用される高分子物質を加水分解する作用があり、洗浄効果が高いためである。塩基性化合物の具体例としては、第四級アンモニウム水酸化物、第四級アンモニウムフッ化物、アルキルアミン、アルカノールアミン、ヒドロキシルアミン（NH_2OH）およびフッ化アンモニウム（NH_4F）よりなる群から選択される１種以上の化合物が挙げられる。洗浄成分は、高圧流体に対し、０．０５～８質量%含まれていることが好ましい。なお、乾燥や現像のために本発明の高圧処理装置を用いる場合は、乾燥または現像すべきレジストの性質に応じて、キシレン、メチルイソブチルケトン、第４級アンモニウム化合物、フッ素系ポリマー等を薬液とすればよい。

【００１７】上記塩基性化合物等の洗浄成分が高圧流体に非相溶である場合には、この洗浄成分を二酸化炭素に溶解もしくは均一分散させる助剤となり得る相溶化剤を第２の薬液として用いることが好ましい。この相溶化剤は、洗浄工程終了後のリンス工程で、汚れを再付着させないようにする作用も有している。

【００１８】相溶化剤としては、洗浄成分を高圧流体と相溶化させることができれば特に限定されないが、メタ

ノール、エタノール、イソプロパノール等のアルコール類や、ジメチルスルホキシド等のアルキルスルホキシドが好ましいものとして挙げられる。相溶化剤は、洗浄工程では、相溶化剤は高圧流体の１０～５０質量%の範囲で適宜選択すればよい。

【００１９】以下、本発明の高圧処理装置を図面を参照しながら説明する。図１には、本発明の高圧処理装置の一実施例を示した。１は高圧流体供給手段であり、必須構成要素である高圧流体用の貯槽１０と加圧ポンプ１２の他、図例では、過冷却器１１、加熱器１３、高圧ボンベ１６と高圧バルブ１５を備えている。

【００２０】高圧流体として、液化または超臨界二酸化炭素を用いる場合、貯槽１０には、通常、液化二酸化炭素が貯留されており、加速度抵抗を含めた配管圧損が大きい場合には、過冷却器１１で予め流体を冷却して、加圧ポンプ１２内でのガス化を防止するとよく、加圧ポンプ１２で流体を加圧すれば高圧液化二酸化炭素を得ることができる。

【００２１】高圧チャンバー２０や３０を大気圧に開放した場合等、系内の二酸化炭素が減少した分を補給する必要があるが、液化二酸化炭素が入った高圧ボンベ１６から液状で二酸化炭素を補給する場合は高圧バルブ１５を介して直接貯層１０へ補給すればよく、ガス状で補強する場合は後述する凝縮器５５を経由して補給するように構成すればよい。

【００２２】加熱器１３は、二酸化炭素を洗浄処理温度に達するよう加熱するためのものであるが、処理温度以下に加熱しておき、または加熱せずに、後述する高圧処理チャンバー毎に設けた加熱手段で、各チャンバーでの処理に適した温度にそれぞれ加熱する構成としてもよい。

【００２３】本装置では、貯槽１０および加圧ポンプ１２を必須構成要素とする高圧流体供給手段１は、各チャンバー２０，３０に共通である。これにより、加圧ポンプ１２の稼働率を上げ、装置全体の設置面積を小さくすることができる。

【００２４】図１では、高圧処理チャンバーを２個備えた例を示している。もちろんチャンバーは２個以上であれば何個あってもよい。チャンバーとしては、開閉自在の蓋を有し、高圧が維持できる容器であれば特に限定されない。

【００２５】第１高圧処理チャンバー（以下、第１チャンバーという）２０は、高圧弁２１と、必要によりチャンバー毎に設けられる加熱手段である加熱器２２とを介して、高圧流体供給手段１と管路で連結されている。分離手段４への管路には高圧弁２９が取り付けられている。また、最終的に高圧流体を大気圧下へ放出するときに用いる圧力調整弁６が、分離手段４への管路とは別の管路に設けられている。

【００２６】第１チャンバーは第１薬液供給手段２Ａと第２薬液供給手段２Ｂとを備えている。第１薬液供給手段２Ａは、第１薬液貯槽２５、圧送ポンプ２４および高圧弁２３から構成されてなり、第２薬液供給手段２Ｂも同様に、第２薬液貯槽２８、圧送ポンプ２７および高圧弁２６から構成されている。薬液供給手段２Ａ、２Ｂは、各圧送ポンプ２４および２７で前記洗浄成分と相溶化剤を所定の圧力とし、それぞれ第１チャンバー２０へ供給する。洗浄成分または相溶化剤だけを用いる高圧処理の場合は、薬液供給手段２Ａのみでよく、また３種以上の薬液を使用するときは、３個以上の薬液供給手段を設けてもよい。

【００２７】第２高圧処理チャンバー（第２チャンバー）３０も、第１チャンバーと同一構成であり、３１が高圧弁、３２が加熱手段（加熱器）であり、３９が分離手段４への管路に設けられている高圧弁で、７が圧力調整弁である。また、３Ａ、３Ｂが薬液供給手段であり、それぞれ、第１および第２薬液貯槽３５、３８、圧送ポンプ３４、３７、高圧弁３３、３６から構成されている。

【００２８】分離手段４は、高圧弁４０と、気体成分用高圧弁４２と、液体（または固体）成分用高圧弁４３と、分離装置４１とから構成されている。ここでは、高圧流体を減圧操作によって気体成分とし、気体成分用高圧弁４２を介して大気に放出するか、もしくは、後述する循環使用システムへと移送する。一方、汚染物質を含む洗浄成分や相溶化剤からなる液体（または固体）成分（減圧によって、固体が析出することもあり得る）は、分離装置４１の塔底から液体（または固体）成分用高圧弁４３を介して排出され、必要に応じて処理される。分離装置４１としては、気液分離が行える種々の装置や、遠心分離機等を使用することができる。

【００２９】なお、図例では、第１および第２チャンバー２０，３０に対し、共通する分離手段４のみが設けられているが、第１チャンバー用分離手段と、第２チャンバー用分離手段というように、各チャンバー毎に分離手段を個別に設けてもよい。各チャンバーで異なる高圧処理を行い、異なる分離処理を行う必要のあるときには、上記構成が好ましい。

【００３０】洗浄工程は、まず、第１チャンバー２０および第２チャンバー３０へ被処理体を出入手段５を用いて装入するところからスタートする。出入手段５は、装置のコンパクト化のため、チャンバー全体で共通とすることが好ましいが、複数の出入手段５を設ける構成としてもよい。出入手段５としては、産業用ロボット等のハンドリング装置や搬送機構が利用可能である。

【００３１】次いで、貯槽１０に蓄えられている高圧流体用媒体を、必要により過冷却器１１で高圧流体用媒体を冷却して液体状態とし、加圧ポンプ１２で第１チャンバー２０および第２チャンバー３０へ圧送する。高圧流体は加熱器１３により超臨界状態となるまで加熱される

が、亜臨界状態や液体状態で第１チャンバー２０および第２チャンバー３０へ送られることもある。

【００３２】第１チャンバー２０への高圧流体の圧送の際には、高圧弁２１は開いているが、第２チャンバー３０用の高圧弁３１は閉じておき、第１チャンバー２０へ高圧流体を供給し終わった後に、高圧弁２１を閉じ、高圧弁３１を開き、第２チャンバー３０への高圧流体の供給を行う。また、高圧弁２１および３２のいずれも開いておき、一度に高圧流体を各チャンバー２０，３０へ圧送してもよい。

【００３３】高圧弁２１と第１チャンバー２０の間、および高圧弁３１と第２チャンバー３０の間には、必要に応じて、加熱手段として加熱器２２および３２が設けられる。加熱器１３と各チャンバー２０、３０との距離が長い場合や、第１チャンバー２０と第２チャンバー３０でも高圧処理温度が異なる場合に、これらの加熱器で高圧流体を加熱することができる。なお、洗浄およびリンス工程は、３１～１２０℃で行うことが好ましい。

【００３４】高圧流体の供給によって、各チャンバー内は所定の圧力となる。図２に、本発明の高圧処理装置によるプロセスサイクルの一例をチャンバー内圧力と時間の経過として示した。第１チャンバー２０を所定の圧力まで昇圧するのに要する時間t_1は、チャンバーの大きさにもよるが、通常３０秒以下である。次いで、第１薬液（洗浄成分）供給手段２Ａの高圧弁２３を開け、貯槽２５から第１チャンバー２０へ洗浄成分をポンプ２４により供給することにより、第１チャンバー２０では洗浄工程が始まる。洗浄工程に相溶化剤が必要ならば、第２薬液供給手段２Ｂの高圧弁２６を開け、貯槽２８から第１チャンバー２０へ洗浄成分をポンプ２７により供給すればよく、洗浄成分と相溶化剤の第１チャンバー２０への供給は、いずれを先にしてもよく、同時であってもよい。また、洗浄成分および相溶化剤の供給は、何回かに分けて行ってもよい。

【００３５】第２チャンバー３０においても同様に高圧流体の供給が完了した時点で、洗浄成分を第１薬液供給手段３Ａにより第２チャンバー３０へ供給し、必要により相溶化剤を第２薬液供給手段３Ｂにより第２チャンバー３０へ供給することで洗浄工程が始まる。

【００３６】洗浄工程中は、各チャンバー２０，３０の下流の高圧弁２９および３９は閉じられている。本発明の装置では、第１チャンバー２０と第２チャンバー３０がそれぞれの薬液供給手段を備えているので、洗浄成分の種類や量および添加タイミングを自在に変えることができる。洗浄工程の時間、すなわち、図２におけるt_2-t_1は、通常、１２０～１８０秒程度で充分である。

【００３７】洗浄工程によって、被処理体に付着していた汚染物質は、チャンバー内の高圧流体と洗浄成分、および必要により添加される相溶化剤との混合流体に溶解することとなる。従って、第１および第２チャンバー２０，３０から、これら汚染物質が溶解している混合流体を排出する必要がある。汚染物質は、洗浄成分および相溶化剤の働きにより高圧流体に溶解しているので、第１および第２チャンバー２０，３０に、高圧流体のみを流通させると、溶解していた汚染物質が析出することが考えられるため、洗浄を行った後は、高圧流体と相溶化剤による第１リンス工程を行った後、高圧流体のみによる第２リンス工程を行う。

【００３８】第１リンス工程は、第１薬液供給手段２Ａおよび３Ａの各高圧弁２３、３３を閉じ、各チャンバー２０，３０の下流の高圧弁２９および３９を同時にまたは順次開け、高圧流体供給手段１により高圧流体を、また、各第２薬液供給手段２Ｂおよび３Ｂから相溶化剤を、それぞれ各チャンバー２０，３０へと連続供給することにより行う。チャンバー内の圧力は洗浄工程と同一とすることが好ましいので、供給速度と排出速度を同一にすることが好ましいが、変えてもよい。高圧流体と相溶化剤を断続的に供給し、供給した分だけ排出するセミバッチ式で行ってもよい。各チャンバー２０、３０から排出される高圧流体は、高圧弁４０を介して分離装置４１へと送られる。

【００３９】高圧流体と相溶化剤との流通により、各チャンバー２０、３０内の汚染物質および洗浄成分は次第に少なくなるので、相溶化剤の供給量は徐々に減らしてもよい。高圧流体と相溶化剤との流通による第１リンス工程では、各チャンバー２０、３０から洗浄成分と汚染物質が全て排出されて、最終的には、高圧流体と相溶化剤とに満たされることとなる。そこで、続いて高圧流体のみを用いた第２リンス工程を行う。なお、第１リンス工程に要する時間、すなわち、図２におけるt_3-t_2は、通常、３０秒程度である。

【００４０】高圧流体のみを用いた第２リンス工程では、第２薬液供給手段２Ｂ、３Ｂの各高圧弁２６、３６を閉じ、各チャンバー２０、３０の中身を高圧流体と相溶化剤の混合流体から、高圧流体のみへと置換する。これにより、高圧処理が終了する。なお、第２リンス工程に要する時間、すなわち、図２におけるt_5-t_4は、通常、３０秒以下である。

【００４１】一方、分離手段４においては、高圧流体と洗浄成分と汚染物質および相溶化剤が各工程に応じて分離装置４１へ流入してくるので、適宜、高圧流体をガス化して気体成分として高圧弁４２から取り出すと共に、洗浄成分、汚染物質、相溶化剤を液体成分（一部固体が含まれる場合がある）として、液体成分用高圧弁４３から取り出す。必要に応じて、分離装置４１を複数個設けたり、各成分に適した種々の後処理を行ってもよい。

【００４２】高圧処理終了後は、高圧弁２９および３９を閉じ、圧力調整弁６および７を開けて減圧し、高圧流体をガス化して放出すれば、各チャンバー２０および３０内は大気圧に復帰する（図２右端）。その後各チャン

バー２０、３０の蓋を開け、出入手段５によって、被処理体を取り出す。二酸化炭素は、大気圧下までの減圧によって蒸発するので、半導体基板等の被処理体は、その表面にシミ等が生じることもなく、また、微細パターンが破壊されることもなく、乾いた状態で取り出せる。

【００４３】上記したように、図１に示した高圧処理装置においては、第１チャンバー２０が薬液供給手段２Ａおよび２Ｂを備え、第２チャンバー３０が薬液供給手段３Ａ、３Ｂを備えているので、高圧弁２１，２３，２６，２９，３１，３３，３６，３９の開閉操作により、それぞれ個別に洗浄、第１リンス、第２リンス工程を行うことができる。従って、被処理体の汚染物質の付着量や種類に応じて、高圧洗浄処理の各工程をきめ細かに変更できる上、各工程を非常に効率的に行える。

【００４４】図３には、高圧流体を循環使用するための装置構成を示す。高圧流体供給手段１は、図１と同じ構成である。また、分離手段４と、高圧流体供給手段１の高圧流体用媒体貯槽１０とを連結管で連結した以外は、図１と同一構成を採用することができるため、図３では他の部分は省略した。分離装置４１での減圧によって高圧流体は気体成分となり、高圧弁４４を介して連結管により液化手段５５へと送られ、液状媒体となって高圧流体用媒体貯槽１０に送られることで、循環使用可能となる。液化手段５５としては、凝縮器等が挙げられる。凝縮器でのエネルギーコストを考慮すると、分離装置４１で大気圧まで減圧するのではなく、４～７ＭＰａ程度に減圧することが好ましい。また、分離装置４１として遠心分離装置や膜分離装置を用い、高圧流体をガス化せずに、洗浄成分、汚染物質および相溶化剤と分離する方法を採用することもできる。

【００４５】半導体の製造工程では、０．２μｍ以上のパーティクルは２００ｍｍφのウエハ上に２０～３０個しか許容されず、高圧流体中の不純物（薬液）濃度も極めて低いレベルに抑えられなければならない。この高純度な流体が必要なのは、特に最後のすすぎに該当する第２リンス工程である。そこで、図３の例では、高純度な流体が必要なときは、高圧弁５３を閉じ、高圧弁５１を開けて、気体成分を精製手段５２を通過させることができるように構成してある。そして、最初の洗浄工程や第１リンス工程で使用する場合には、高圧弁５１を閉じ、高圧弁５３を開け、精製手段５２を経ずに、フィルター５４を通して液化手段５５へ移送する流路を用いることができる。精製手段５２としては、活性炭等の吸着剤が充填されている吸着塔等が挙げられる。精製手段５２を経た高純度な流体と未精製の流体とが別々の貯槽に移送されるように構成してもよい。

【００４６】上記図３の構成の装置では、流体を循環使用することで、高圧流体を得るためのエネルギーコストが低減されるが、高圧流体に清浄度の高さが要求される場合は常にフレッシュな高圧流体を用いることが好ましいので、いずれを選択するかは、精製の技術的難易度や経済性を勘案して適宜決定すればよい。

【００４７】本発明の高圧処理装置は、半導体製造工程等での半導体の洗浄に有用であるが、クリーンルーム内に装置全体を設置してもよいし、高圧処理チャンバーと出入手段を箱状体の中に配設し、この箱状体のみをクリーンルーム内に設置して、高圧流体供給手段や分離手段をクリーンルーム外に設置する構成を採用してもよい。薬液供給手段はいずれにあってもよい。

【００４８】

【発明の効果】本発明の高圧処理装置は、高圧処理チャンバー毎に薬液供給手段を設けているので、各チャンバーで行う処理に応じて、きめ細かい薬液供給条件を種々設定できる。従って、半導体基板の高圧流体による洗浄処理に好適に用いることができる。

【図面の簡単な説明】

【図１】本発明の高圧処理装置の一実施例を示す説明図である。

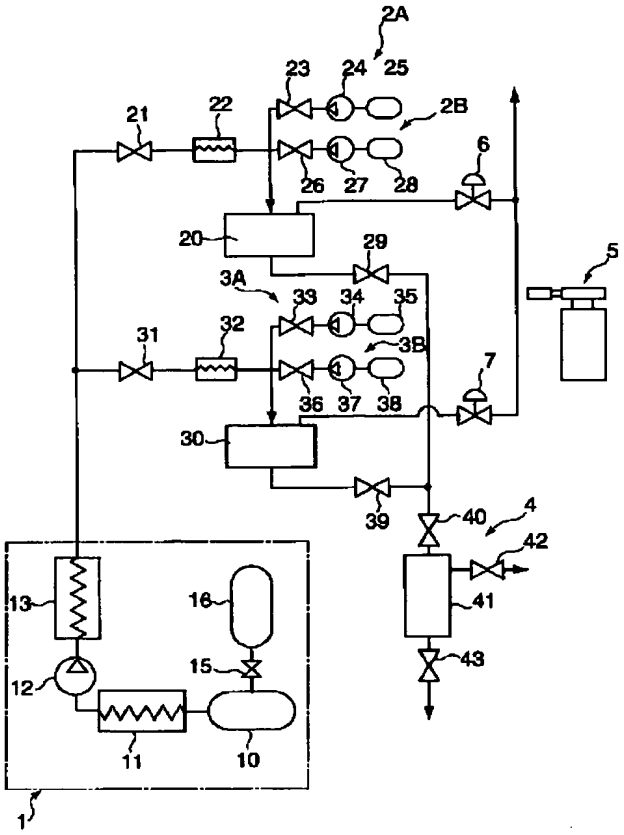
【図２】高圧処理チャンバー内の圧力と時間の関係を示すグラフである。

【図３】本発明の高圧処理装置の他の実施例を示す説明図である。

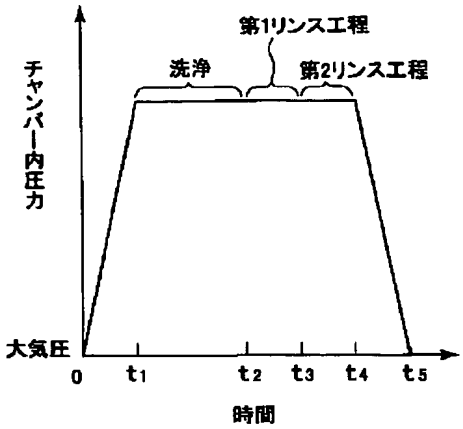
【符号の説明】

１　高圧流体供給手段
１２　圧送ポンプ
２０、３０　高圧処理チャンバー
２Ａ、３Ａ　第１薬液供給手段
２Ｂ、３Ｂ　第２薬液供給手段
４　分離手段
５　出入手段
６，７　圧力調整弁

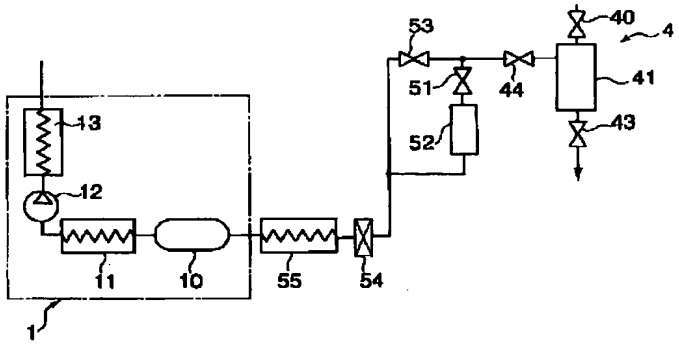
【図１】



【図２】



【図３】



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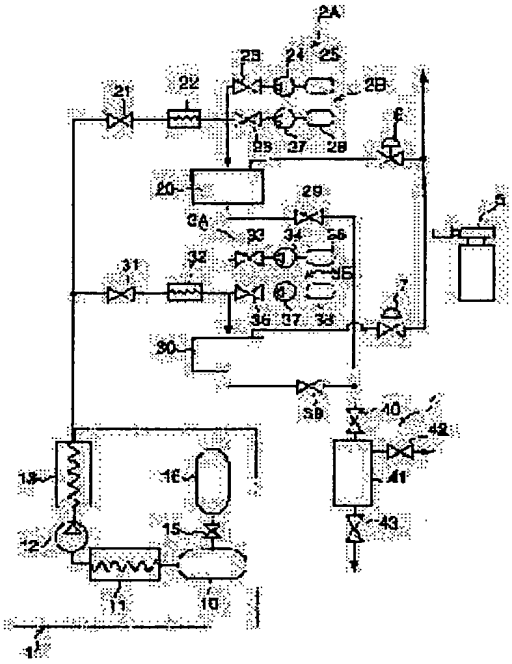
(54) HIGH PRESSURE PROCESSOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a high pressure processor capable of efficiently supplying a liquid chemical at a required timing and effectively reducing costs in the high pressure processor installable inside a clean room.
SOLUTION: The high pressure processor is a device for performing removal processing of unrequired materials on an object to be processed by bringing a high pressure fluid and the liquid chemical other than the high pressure fluid into contact with the object under a pressure, and is provided with a plurality of high pressure processing chambers, a common high pressure fluid supply means for supplying the high pressure fluid to the high pressure processing chambers, a separation means for separating gaseous components from the mixture of the high pressure fluid and the liquid chemical discharged from the high pressure processing chambers after processing and a common take-out/ take-in means for taking the object in and out of the respective high pressure processing chambers. A liquid chemical supply means for supplying the liquid chemical to the high pressure processing chamber is provided for each high pressure processing chamber.



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CLAIMS

[Claim(s)]
[Claim 1] It is equipment for contacting drug solutions other than a high-pressure fluid and a high-pressure fluid on a processed object under pressurization, and performing removal processing of the undesired substance on a processed object. Two or more high-pressure processing chambers, The common high-pressure fluid supply means for supplying a high-pressure fluid to these high-pressure processing chambers, The separation means for separating a gas component from the mixture of the high-pressure fluid and drug solution which are discharged from said high-pressure processing chamber after processing, The high-pressure processor characterized by establishing the drug solution supply means for having an in-and-out means for going a processed object in and out to said each high-pressure processing chamber, and supplying a drug solution to a high-pressure processing chamber for every high-pressure processing chamber.
[Claim 2] The high-pressure processor according to claim 1 which establishes two or more drug solution supply means for every high-pressure processing chamber, respectively.
[Claim 3] The high-pressure processor according to claim 1 or 2 which establishes a separation means for every high-pressure processing chamber, respectively.
[Claim 4] The high-pressure processor according to claim 1 to 3 which establishes a heating means near the inlet port to each high-pressure processing chamber.
[Claim 5] The high-pressure processor according to claim 1 to 4 constituted so that the gas component which arranged the liquefaction means in this interconnecting tube, and was separated with the separation means might be reused as a high-pressure fluid, while preparing the interconnecting tube which connects said separation means and said high-pressure fluid supply means.
[Claim 6] The high-pressure processor according to claim 1 to 5 which arranged each high-pressure processing chamber and an in-and-out means into one box-like object.

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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is installed in a clean room, concerning the optimal high-pressure processor, when washing efficiently the processed object which has detailed irregularity (fine structure front face) on a front face like a semi-conductor substrate, and it relates to the high-pressure processor used in order to carry out exfoliation removal of the pollutants, such as a resist which adhered to the substrate front face in the semi-conductor manufacture process, from a substrate. Moreover, this invention relates to the high-pressure processor for drying or developing a substrate.
[0002]
[Description of the Prior Art] When carrying out pattern formation using a resist in a semi-conductor manufacture process, the washing process for removing discard and pollutants, such as a resist which becomes unnecessary after pattern formation, and an etching polymer which generates at the time of etching and remains on a substrate, from a substrate turns into an indispensable process.
[0003] Since a semi-conductor manufacture process is performed in a clean room, it is desirable to also perform a washing process in a clean room. However, since a clean room requires cost considerably also not only in the construction but in maintenance, installation area of a washing station is small and excelling in functionality and detergency is called for.
[0004] Conventionally, the wet washing approach which is immersed and carries out the rinse of the semi-conductor substrate etc. to exfoliation liquid (penetrant remover) with alcohol or ultrapure water after that as the semi-conductor washing approach has been adopted. Although the compound of an organic system or an inorganic system has been used for exfoliation liquid The problem of the ability not to make exfoliation liquid permeate the crevice of the pattern made detailed according to causes, like the surface tension and viscosity of a liquid are high, Since there was a problem on which the heights of a pattern collapse by the capillary force produced in a gas-liquid interface, the cubical expansion by heating in the case of desiccation, etc. when drying exfoliation liquid and a rinse, recently For example, examination which uses the high-pressure fluid of hypoviscosity like a supercritical carbon dioxide as exfoliation liquid or a rinse is made.
[0005] For example, it is the washing station which can be installed in a clean room, and the equipment for carrying out dissolution removal of the contaminations, such as a part for the moisture of a semi-conductor wafer front face and fats and oils and ester, by supercritical fluid is indicated by JP,5-226311,A. Although removal for the moisture on the front face of a substrate or fats and oils etc. can be easily perform as indicate by the above-mentioned official report since the carbon dioxide fluid have the solvent power of hexane extent supposing it evaporate simply under atmospheric pressure as high pressure or supercritical fluid , it excel in safety and it moreover use a cheap carbon dioxide , the solvent power over macromolecule pollutants , such as a resist and an etching polymer , be inadequate , and it be difficult to exfoliate and remove these pollutants by the carbon dioxide independent .
[0006] For this reason, the drug solution for washing is further added to a carbon dioxide, and it

is thought desirable to exfoliate and remove a macromolecule pollutant. Although it is necessary to change various additions and timing to add with the class of resist, the coating weight of a pollutant, etc., since it is premised on washing only by supercritical fluid, this drug solution for washing is not taken into consideration at all about the supply means of the drug solution for washing by said JP,5-226311,A. Furthermore, it is necessary to carry out an equipment configuration so that processing of the high-pressure fluid containing the contaminant drawn from a high-pressure processing chamber can be performed taking the balance of the purity of an energy loss (cost) and a high-pressure fluid etc.

[0007]

[Problem(s) to be Solved by the Invention] So, in this invention, in the high-pressure processor which can be installed in a clean room, the drug solution could be efficiently supplied to required timing, and it hung up offering a high-pressure processor effective in cost reduction as a technical problem.

[0008]

[Means for Solving the Problem] The high-pressure processor of this invention is equipment for contacting drug solutions other than a high-pressure fluid and a high-pressure fluid on a processed object under pressurization, and performing removal processing of the undesired substance on a processed object. Two or more high-pressure processing chambers, The common high-pressure fluid supply means for supplying a high-pressure fluid to these high-pressure processing chambers, The separation means for separating a gas component from the mixture of the high-pressure fluid and drug solution which are discharged from said high-pressure processing chamber after processing, It has an in-and-out means for going a processed object in and out to said each high-pressure processing chamber, and has a summary at the place in which the drug solution supply means for supplying a drug solution to a high-pressure processing chamber was formed for every high-pressure processing chamber.

[0009] Since it had two or more high-pressure processing chambers, and the effectiveness of down stream processing increased and the drug solution supply means was established for every chamber, different processing for every chamber can be performed.

[0010] If the configuration which establishes two or more drug solution supply means for every high-pressure processing chamber, respectively is adopted, two or more kinds of drug solutions can be supplied to a high-pressure processing chamber to separate timing. If the configuration which establishes a separation means for every high-pressure processing chamber, respectively is adopted, the conditions when separating a gas component from the polluted high-pressure fluid can be suitably changed according to the washing conditions of a high-pressure processing chamber etc. If the configuration which establishes a heating means near the inlet port to each high-pressure processing chamber is adopted, the processing temperature of each high-pressure processing chamber can be changed for every chamber.

[0011] While preparing the interconnecting tube which connects said separation means and said high-pressure fluid supply means, a liquefaction means is arranged in this interconnecting tube, and if the configuration which reuses the gas component separated with the separation means as said high-pressure fluid is adopted, the cyclic use of waste water of the high-pressure fluid can be carried out.

[0012] When adopting the configuration which arranges each high-pressure processing chamber and an in-and-out means into one box-like object and leak of a high-pressure fluid arises from a high-pressure processing chamber by installing the leak detector in the box-like object, a required safety precaution can be performed promptly. Moreover, if a high-pressure processing chamber and an in-and-out means are installed in a clean room and other means are installed outside a clean room, since the occupancy area of the high-pressure processor occupied in a clean room becomes small, it is suitable.

[0013]

[Embodiment of the Invention] With the processing in the high-pressure processor of this invention, the washing processing which exfoliates and removes a pollutant is raised from the processed object to which the pollutant has adhered like the semi-conductor substrate to which the resist adhered as an example of representation. As a processed object, it is not limited to a

semi-conductor substrate, but discontinuous or a thing to which the continuation layer forms or remains of dissimilar material is contained on various base materials, such as a metal, plastics, and ceramics. Moreover, all processings (for example, desiccation, development, etc.) that remove the unnecessary matter from on a processed object can be made into the object of the high-pressure processor of this invention by not being restricted to washing processing using drug solutions other than a high-pressure fluid and a high-pressure fluid.

[0014] It is the point that it is easy to change into safety, a price, and a supercritical condition as a high-pressure fluid used in the high-pressure processor of this invention, and a carbon dioxide is desirable. In addition to a carbon dioxide, water, ammonia, nitrous oxide, ethanol, etc. are usable. Using a high-pressure fluid has a high diffusion coefficient, and it is because the dissolved pollutant can be distributed in a medium, and when it is made high pressure more and made supercritical fluid, it is because it comes to have the middle property of a gas and a liquid and a detailed pattern part can be permeated now one layer of nearby. Moreover, high-pressure fluid density can contain a lot of additives (drug solution) for whether your being Haruka in a liquid compared with near and a gas.

[0015] Here, the high-pressure fluid in this invention is a fluid of the pressure of 1 or more MPas. The high-pressure fluids which can be used preferably are high solubility, hypoviscosity, and a fluid with which the property of high diffusibility is accepted, and a still more desirable thing is the fluid of a supercritical condition or a subcritical state. What is necessary is just to set a carbon dioxide to 31 degrees C and 7.1 MPas or more, for considering as supercritical fluid. As for the rinse process after washing in a washing list, desiccation / development process, etc., it is desirable to use subcritical [of 5-30MPa] (high-pressure fluid) or supercritical fluid, and it is more desirable to perform these processings under 7.1 - 20MPa. Hereafter, as removal processing performed with the high-pressure processor of this invention, although washing processing is explained as an example of representation, as described above, high-pressure processing is not restricted only to washing processing.

[0016] In the high-pressure processor of this invention, in order to also remove macromolecule pollutants adhering to a semi-conductor substrate, such as a resist and an etching polymer, in consideration of the point that a detergency is inadequate, a drug solution is added and washing processing is performed only by the high-pressure fluid, such as a carbon dioxide. As a drug solution, it is desirable to use a basic compound as a washing component. There is an operation which hydrolyzes the high polymer used abundantly at a resist, and it is because the cleaning effect is high. One or more sorts of compounds chosen from the group which consists of a quaternary ammonium hydroxide, a quaternary ammonium fluoride, alkylamine, alkanolamine, a hydroxylamine (NH2OH), and ammonium fluoride (NH4F) as an example of a basic compound are mentioned. As for a washing component, it is desirable 0.05-8 mass % To be contained to a high-pressure fluid. In addition, what is necessary is just to let a xylene, methyl isobutyl ketone, the 4th class ammonium compound, a fluorine system polymer, etc. be drug solutions according to the property of the resist which should be dried or developed, when you use the high-pressure processor of this invention for desiccation or development.

[0017] When washing components, such as the above-mentioned basic compound, are immiscible in a high-pressure fluid, it is desirable to use the compatibilizer which can turn into an assistant which makes a carbon dioxide dissolve or homogeneity distribute this washing component as the 2nd drug solution. This compatibilizer also has the operation to which it is not made to carry out the reattachment of the dirt at the rinse process after washing process termination.

[0018] Although it will not be limited as a compatibilizer especially if a washing component can be made to compatibility-ize with a high-pressure fluid, alcohols, such as a methanol, ethanol, and isopropanol, and alkyl sulfoxides, such as dimethyl sulfoxide, are mentioned as a desirable thing. A compatibilizer should just choose a compatibilizer suitably in the range of 10 - 50 mass % of a high-pressure fluid at a washing process.

[0019] Hereafter, the high-pressure processor of this invention is explained, referring to a drawing. One example of the high-pressure processor of this invention was shown in drawing 1 . 1 is a high-pressure fluid supply means, and is equipped with the subcooler 11, the heater 13, the high-pressure bomb 16, and the high-pressure bulb 15 by the example of drawing besides

the tank 10 for high-pressure fluids which is an indispensable component, and a booster pump 12.
[0020] When the piping pressure loss which the liquefaction carbon dioxide is usually stored by the tank 10 when using liquefaction or a supercritical carbon dioxide, and included acceleration resistance in it is large as a high-pressure fluid, a fluid is beforehand cooled by the subcooler 11, it is good to prevent gasification within a booster pump 12, and if a fluid is pressurized by the booster pump 12, a high-pressure liquefaction carbon dioxide can be obtained.
[0021] What is necessary is to supply the part to which the carbon dioxides in a system decreased in number, when the high-pressure chamber 20 and 30 are wide opened to atmospheric pressure, but just to constitute that what is necessary is for it to be liquefied from the high-pressure bomb 16 containing a liquefaction carbon dioxide, and just to supply the direct storage layer 10 through the high-pressure bulb 15 when supplying a carbon dioxide, so that it may supply via the condenser 55 mentioned later when reinforcing with a gas.
[0022] Although a heater 13 is for heating a carbon dioxide so that washing processing temperature may be reached, it is the heating means established for every high-pressure processing chamber mentioned later, without heating below to processing temperature or heating, and is good for the temperature suitable for processing by each chamber also as a configuration heated, respectively.
[0023] The high-pressure fluid supply means 1 which uses a tank 10 and a booster pump 12 as an indispensable component with this equipment is common to each chambers 20 and 30. Thereby, the operating ratio of a booster pump 12 can be gathered and installation area of the whole equipment can be made small.
[0024] Drawing 1 shows the example equipped with two high-pressure processing chambers. Of course, as long as how many chambers are two or more pieces, there may be. As a chamber, it has the lid which can be opened and closed freely, and it will not be limited especially if it is the container which can maintain high pressure.
[0025] The 1st high-pressure processing chamber (henceforth the 1st chamber) 20 is connected with the high-pressure fluid supply means 1 in the duct through the high pressure valve 21 and the heater 22 which is the heating means established for every chamber as occasion demands. The high pressure valve 29 is attached in the duct to the separation means 4. Moreover, the pressure regulating valve 6 used when emitting a high-pressure fluid to under atmospheric pressure finally is formed in the duct other than the duct to the separation means 4.
[0026] The 1st chamber is equipped with 1st drug solution supply means 2A and 2nd drug solution supply means 2B. It comes to consist of 1st drug solution supply means 2A a 1st drug solution tank 25, a feeding pump 24, and a high pressure valve 23, and 2nd drug solution supply means 2B consists of a 2nd drug solution tank 28, a feeding pump 27, and a high pressure valve 26 similarly. Drug solution supply means 2A and 2B make said washing component and compatibilizer a predetermined pressure with each feeding pumps 24 and 27, and supply them to the 1st chamber 20, respectively. In the high-pressure processing only using a washing component or a compatibilizer, when only drug solution supply means 2A uses three or more sorts of drug solutions, three or more drug solution supply means may be established.
[0027] The 2nd high-pressure processing chamber (the 2nd chamber) 30 is also the same configuration as the 1st chamber, 31 is a high pressure valve, 32 is a heating means (heater), 39 is the high pressure valve prepared in the duct to the separation means 4, and 7 is a pressure regulating valve. Moreover, 3A and 3B are drug solution supply means, and consist of 1st and 2nd drug solution tanks 35 and 38, feeding pumps 34 and 37, and high pressure valves 33 and 36, respectively.
[0028] The separation means 4 consists of the high pressure valve 40, a high pressure valve 42 for gas components, a high pressure valve 43 for liquid (or solid-state) components, and a decollator 41. Here, it transports to the cyclic-use-of-waste-water system which uses a high-pressure fluid as a gas component, and emits it to atmospheric air through the high pressure valve 42 for gas components by reduced pressure actuation, or is mentioned later. The liquid (or solid-state) component (a solid-state can deposit with reduced pressure) which consists of a washing component containing a pollutant or a compatibilizer on the other hand is discharged

through the high pressure valve 43 for liquid (or solid-state) components from the bottom of a decollator 41, and is processed if needed. As a decollator 41, the equipment of the versatility which can perform vapor liquid separation, a centrifugal separator, etc. can be used.
[0029] In addition, although only a separation means 4 to be common is established to the 1st and 2nd chambers 20 and 30 in the example of drawing, a separation means may be established according to an individual for every chamber like the separation means for the 1st chamber, and the separation means for the 2nd chamber. When there is the need of performing high-pressure processing which is different by each chamber, and performing different separation processing, the above-mentioned configuration is desirable.
[0030] A washing process is first started from the place which inserts in a processed object using the in-and-out means 5 to the 1st chamber 20 and the 2nd chamber 30. Although it is desirable to suppose that it is common to the whole chamber because of miniaturization of equipment as for the in-and-out means 5, it is good also as a configuration which establishes two or more in-and-out means 5. As an in-and-out means 5, handling devices and conveyance devices, such as an industrial robot, are available.
[0031] Subsequently, the medium for high-pressure fluids is cooled by the subcooler 11 as occasion demands, and the medium for high-pressure fluids currently stored in the tank 10 is made into a liquid condition, and is fed to the 1st chamber 20 and the 2nd chamber 30 by the booster pump 12. Although it is heated until a high-pressure fluid will be in a supercritical condition with a heater 13, it may be sent to the 1st chamber 20 and the 2nd chamber 30 in the state of a subcritical state or a liquid.
[0032] In the case of feeding of the high-pressure fluid to the 1st chamber 20, although the high pressure valve 21 is open, after the high pressure valve 31 for 2nd chamber 30 closes it and it finishes supplying a high-pressure fluid to the 1st chamber 20, it closes a high pressure valve 21, opens a high pressure valve 31, and supplies the high-pressure fluid to the 2nd chamber 30. Moreover, all of high pressure valves 21 and 32 are opened, and a high-pressure fluid may be fed to each chambers 20 and 30 at once.
[0033] Between a high pressure valve 21 and the 1st chamber 20 and between a high pressure valve 31 and the 2nd chamber 30, heaters 22 and 32 are formed as a heating means if needed. When the distance of a heater 13 and each chambers 20 and 30 is long, or when high-pressure processing temperature differs also by the 1st chamber 20 and the 2nd chamber 30, a high-pressure fluid can be heated with these heaters. In addition, as for washing and a rinse process, it is desirable to carry out at 31-120 degrees C.
[0034] By supply of a high-pressure fluid, the inside of each chamber serves as a predetermined pressure. An example of the process cycle by the high-pressure processor of this invention was shown in drawing 2 as chamber internal pressure and the passage of time. Although the time amount t1 which takes the 1st chamber 20 to carry out a pressure up to a predetermined pressure is based also on the magnitude of a chamber, it is usually 30 or less seconds. Subsequently, in the 1st chamber 20, a washing process starts by opening the high pressure valve 23 of 1st drug solution (washing component) supply means 2A, and supplying a washing component to the 1st chamber 20 with a pump 24 from a tank 25. As long as a compatibilizer is required for a washing process, the supply to a washing component and the 1st chamber 20 of a compatibilizer may carry out any first, and may be [that what is necessary is to open the high pressure valve 26 of 2nd drug solution supply means 2B, and just to supply a washing component to the 1st chamber 20 with a pump 27 from a tank 28] simultaneous. moreover, supply of a washing component and a compatibilizer may be performed by being alike several times and dividing.
[0035] When supply of a high-pressure fluid is similarly completed in the 2nd chamber 30, a washing process starts by supplying a washing component to the 2nd chamber 30 by 1st drug solution supply means 3A, and supplying a compatibilizer to the 2nd chamber 30 by 2nd drug solution supply means 3B as occasion demands.
[0036] The high pressure valves 29 and 39 of the lower stream of a river of each chambers 20 and 30 are closed by the inside of a washing process. With the equipment of this invention, since the 1st chamber 20 and the 2nd chamber 30 are equipped with each drug solution supply means,

the class, the amount, and addition timing of a washing component are changeable free. t2-t1 in the time amount of a washing process, i.e., drawing 2 , is usually enough in about 120 - 180 seconds.

[0037] The contaminant which had adhered to the processed object according to the washing process will dissolve in the high-pressure fluid in a chamber, a washing component, and an interflow object with the compatibilizer added by the need. Therefore, it is necessary to discharge the interflow object which these pollutants are dissolving from the 1st and 2nd chambers 20 and 30. Since the pollutant is dissolving in the high-pressure fluid by work of a washing component and a compatibilizer and it can consider that the dissolved pollutant deposits, if it circulates only a high-pressure fluid to the 1st and 2nd chambers 20 and 30, after it washes and it performs the 1st rinse process by the high-pressure fluid and the compatibilizer, it performs the 2nd rinse process only by the high-pressure fluid.

[0038] the 1st rinse process — each high pressure valves 23 and 33 of the 1st drug solution supply means 2A and 3A — closing — the high pressure valves 29 and 39 of the lower stream of a river of each chambers 20 and 30 — coincidence — or — one by one — opening — the high-pressure fluid supply means 1 — a high-pressure fluid — moreover, every — it carries out by carrying out continuation supply of the compatibilizer from 2nd drug solution supply means 2B and 3B to each chambers 20 and 30, respectively. You may change, although it is desirable to make a speed of supply and an elimination rate the same since it is desirable to suppose that the pressure in a chamber is the same as that of a washing process. A high-pressure fluid and a compatibilizer may be performed by the semi batch type which supplies intermittently and discharges only a part to have supplied. The high-pressure fluid discharged from each chambers 20 and 30 is sent to a decollator 41 through a high pressure valve 40.

[0039] By circulation with a high-pressure fluid and a compatibilizer, since the pollutant and washing component in each chamber 20 and 30 decrease gradually, the amount of supply of a compatibilizer may be reduced gradually. All of a washing component and a pollutant will be discharged from each chambers 20 and 30, and, finally it will be filled with the 1st rinse process by circulation with a high-pressure fluid and a compatibilizer by a high-pressure fluid and the compatibilizer. Then, the 2nd rinse process only using a high-pressure fluid is performed continuously. In addition, t3-t2 in the time amount which the 1st rinse process takes, i.e., drawing 2 , are usually about 30 seconds.

[0040] At the 2nd rinse process only using a high-pressure fluid, each high pressure valves 26 and 36 of 2nd drug solution supply means 2B and 3B are closed, and the contents of each chambers 20 and 30 are permuted from a high-pressure fluid and the interflow object of a compatibilizer only to a high-pressure fluid. Thereby, high-pressure processing is completed. In addition, t5-t4 in the time amount which the 2nd rinse process takes, i.e., drawing 2 , are usually 30 or less seconds.

[0041] On the other hand, since a high-pressure fluid, a washing component, a pollutant, and a compatibilizer flow into a decollator 41 according to each process, while gasifying a high-pressure fluid and taking out from a high pressure valve 42 as a gas component suitably in the separation means 4, a washing component, a pollutant, and a compatibilizer are taken out from the high pressure valve 43 for liquid components as a liquid component (a solid-state may be contained in part). If needed, two or more decollators 41 may be formed, or various after treatment suitable for each component may be performed.

[0042] After high-pressure processing termination closes high pressure valves 29 and 39, and opens and decompresses pressure regulating valves 6 and 7, and if a high-pressure fluid is gasified and emitted, the inside of each chamber 20 and 30 will return to atmospheric pressure (drawing 2 right end). The lid of each chambers 20 and 30 is opened after that, and a processed object is taken out with the in-and-out means 5. Since a carbon dioxide evaporates with reduced pressure under atmospheric pressure, processed objects, such as a semi-conductor substrate, can be taken out in the condition of having got dry, without [without silverfish etc. arises on the front face, and] destroying a detailed pattern.

[0043] Since the 1st chamber 20 was equipped with drug solution supply means 2A and 2B and the 2nd chamber 30 is equipped with the drug solution supply means 3A and 3B in the high-

pressure processor shown in drawing 1 as described above, the switching operation of high pressure valves 21, 23, 26, 29, 31, 33, 36, and 39 can perform washing, the 1st rinse, and the 2nd rinse process according to an individual, respectively. Therefore, when each process of high-pressure washing processing can be finely changed according to the coating weight and the class of a pollutant of processed object, each process can be performed very efficiently.

[0044] The equipment configuration for carrying out the cyclic use of waste water of the high-pressure fluid is shown in drawing 3 . The high-pressure fluid supply means 1 is the same configuration as drawing 1 . Moreover, since the same configuration as drawing 1 was employable except having connected the separation means 4 and the medium tank 10 for high-pressure fluids of the high-pressure fluid supply means 1 by the interconnecting tube, other parts were omitted in drawing 3 . With reduced pressure with a decollator 41, a high-pressure fluid serves as a gas component, it is being sent to the liquefaction means 55 by the interconnecting tube through a high pressure valve 44, becoming a liquefied medium and sent to the medium tank 10 for high-pressure fluids, and the cyclic use of waste water of it becomes possible. A condenser etc. is mentioned as a liquefaction means 55. When the energy cost in a condenser is taken into consideration, it is desirable to decompress to 4 - 7MPa extent rather than to to decompress to atmospheric pressure with a decollator 41. Moreover, a washing component, a pollutant and a compatibilizer, and the approach of separating can also be adopted, without gasifying a high-pressure fluid, using a centrifugal separator and a membrane separation device as a decollator 41.

[0045] In the production process of a semi-conductor, only 20-30 pieces must be permitted on the wafer of 200mmphi, but particle 0.2 micrometers or more must be stopped by level also with the very low impurity (drug solution) concentration in a high-pressure fluid. Especially the thing this high grade fluid of whose is the need is the 2nd rinse process applicable to a rinse of the last. So, a high pressure valve 53 is closed, a high pressure valve 51 is opened, and when a high grade fluid is required, the gas component is constituted from an example of drawing 3 so that the purification means 52 can be passed. And when using it at the first washing process and 1st rinse process, a high pressure valve 51 can be closed, a high pressure valve 53 can be opened, and the passage transported to the liquefaction means 55 through a filter 54 can be used, without passing through the purification means 52. As a purification means 52, the adsorption tower where it fills up with adsorbents, such as activated carbon, is mentioned. You may constitute so that the high grade fluid which passed through the purification means 52, and a non-refined fluid may be transported to a separate tank.

[0046] Since it is desirable to use an always fresh high-pressure fluid when the height of cleanliness is required of a high-pressure fluid although the energy cost for obtaining a high-pressure fluid is reduced by carrying out the cyclic use of waste water of the fluid with the equipment of the configuration of above-mentioned drawing 3 , any are chosen takes into consideration the technical difficulty and economical efficiency of purification, and it should just be determined suitably.

[0047] Although the high-pressure processor of this invention is useful to washing of the semi-conductor in a semi-conductor production process etc., the configuration which may install the whole equipment in a clean room, arranges a high-pressure processing chamber and an in-and-out means into a box-like object, installs only this box-like object in a clean room, and installs a high-pressure fluid supply means and a separation means outside a clean room may be used for it. A drug solution supply means may be in any.

[0048]

[Effect of the Invention] Since the high-pressure processor of this invention has established the drug solution supply means for every high-pressure processing chamber, it can set up various fine drug solution conditions of supply according to the processing performed by each chamber. Therefore, it can use suitable for the washing processing by the high-pressure fluid of a semi-conductor substrate.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the explanatory view showing one example of the high-pressure processor of this invention.
[Drawing 2] It is the graph which shows the pressure in a high-pressure processing chamber, and the relation of time amount.
[Drawing 3] It is the explanatory view showing other examples of the high-pressure processor of this invention.
[Description of Notations]
1 High-Pressure Fluid Supply Means
12 Feeding Pump
20 30 High-pressure processing chamber
2A, 3A The 1st drug solution supply means
2B, 3B The 2nd drug solution supply means
4 Separation Means
5 In-and-out Means
6 Seven Pressure regulating valve

[Translation done.]